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(12) **United States Patent**
Whiting

(10) **Patent No.: US 9,464,440 B2**
(45) **Date of Patent: *Oct. 11, 2016**

(54) **INTEGRATED SAFETY RAIL PROTECTION SYSTEM**

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(73) Assignee: **SafePro, L.P.**, Dallas, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 46 days.

This patent is subject to a terminal disclaimer.

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(65) **Prior Publication Data**

US 2014/0225052 A1 Aug. 14, 2014

Related U.S. Application Data

(63) Continuation of application No. 12/825,265, filed on Jun. 28, 2010, now Pat. No. 8,726,577.

(60) Provisional application No. 61/269,593, filed on Jun. 26, 2009.

(51) **Int. Cl.**
E04H 17/14 (2006.01)
E04D 13/03 (2006.01)
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(52) **U.S. Cl.**
CPC ***E04D 13/0335*** (2013.01); ***E02D 29/127*** (2013.01); ***E04G 21/3204*** (2013.01); ***E06C 7/006*** (2013.01); ***E06C 7/182*** (2013.01)

(58) **Field of Classification Search**
CPC E02D 29/127; E04D 13/0335; E04G 21/3204; E06C 7/006; E06C 7/182; E06B 11/02; E04H 17/16; E04H 17/18
USPC 256/25–27, 38, 39, 59; 52/19, 20, 174, 52/184; 182/106, 113
See application file for complete search history.

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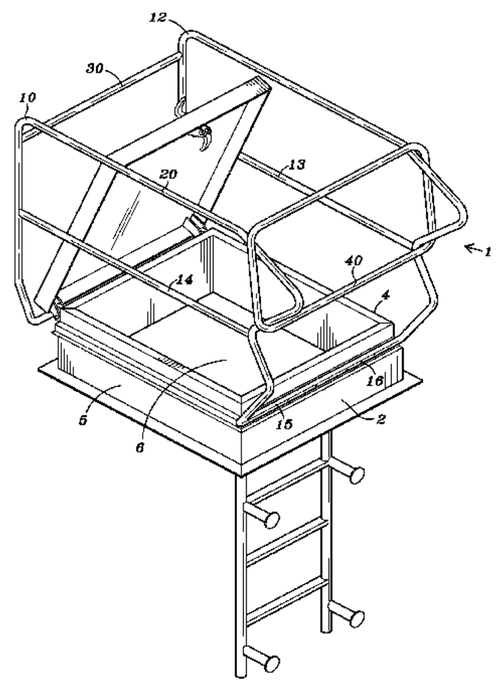
(57) **ABSTRACT**

A safety rail system in some embodiments may include integrated ergonomic hand-grip projections, and structures for affixing the system for egress and ingress through an opening, such as roof or floor access holes. A self-closing gravity gate may be provided acting as additional hand-grip, support, and barrier. The safety rail system may be constructed and assembled using a unique continuous tubular structure of converging vertical and angular upright post with horizontal upper rail, forward protruding ergonomically effecting hand-grip and opposing directionally horizontal lower attachment support means reducing lateral motion and allows installation for new construction or retro fitting of existing openings.

23 Claims, 8 Drawing Sheets



(51) **Int. Cl.**

E04G 21/32	(2006.01)
E06C 7/00	(2006.01)
E06C 7/18	(2006.01)
E02D 29/12	(2006.01)

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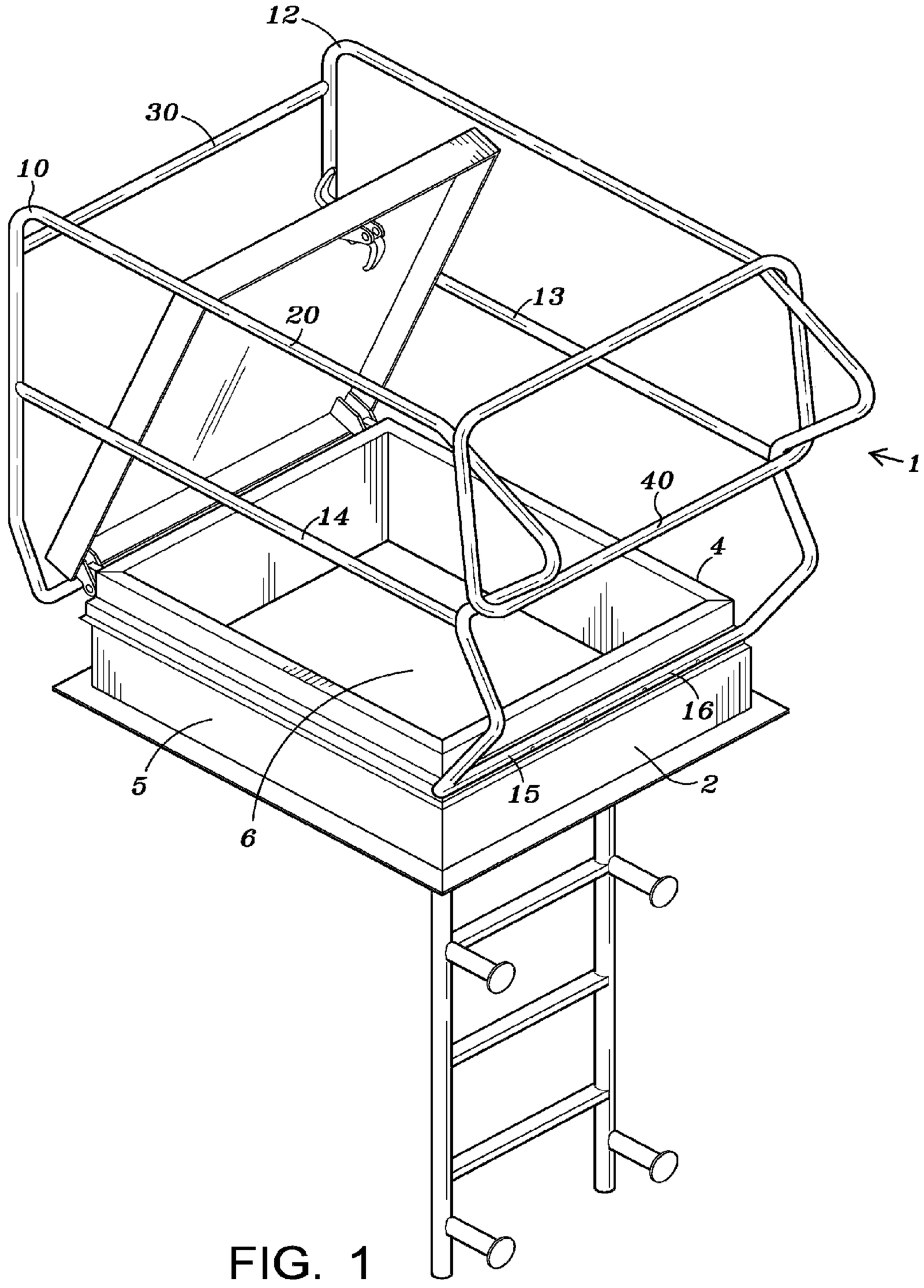

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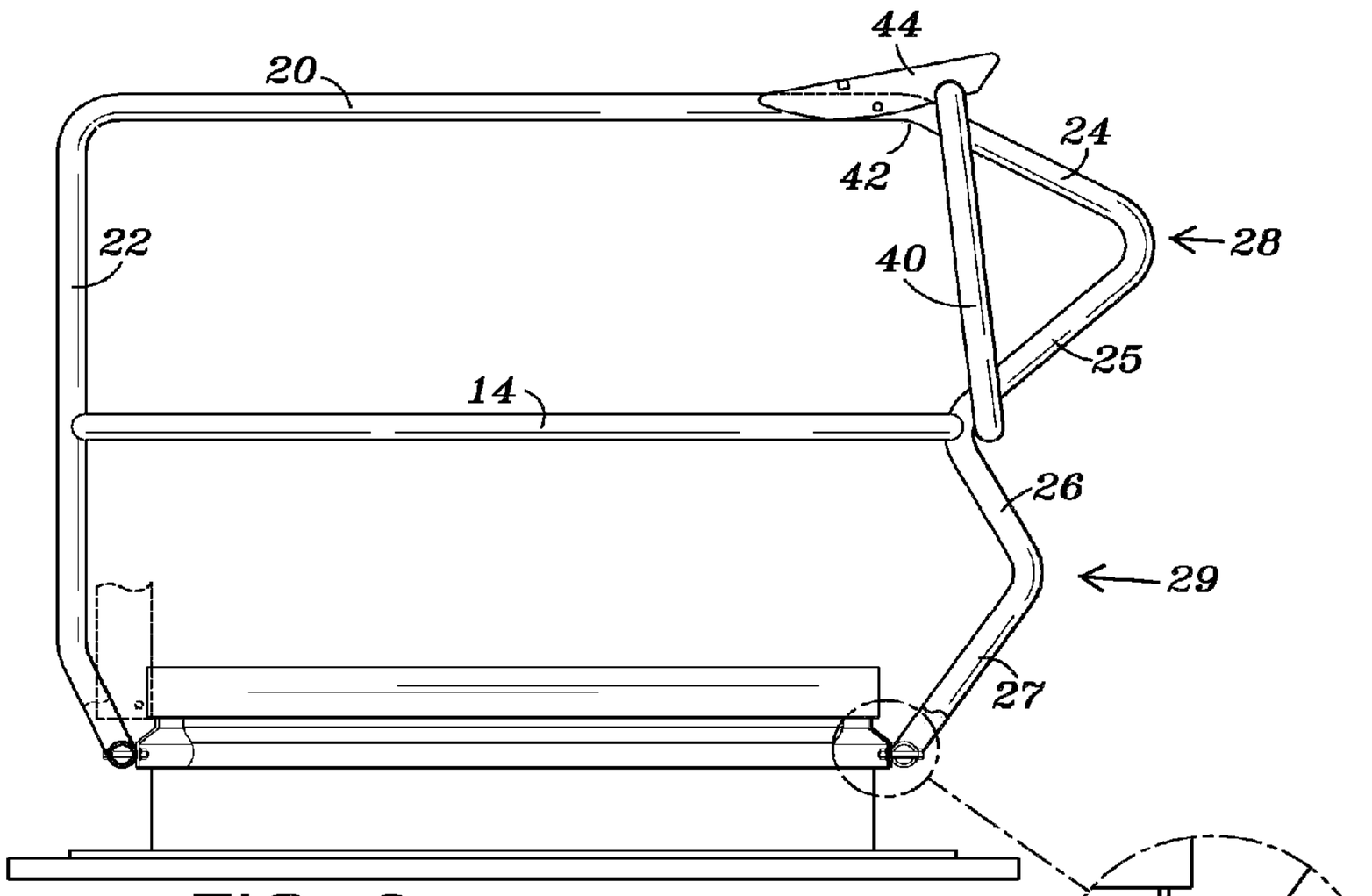

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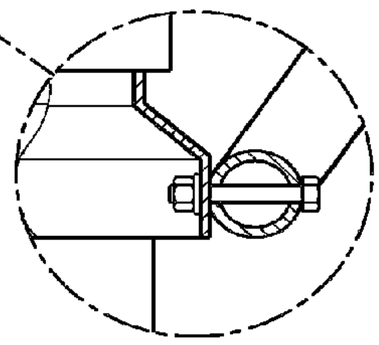

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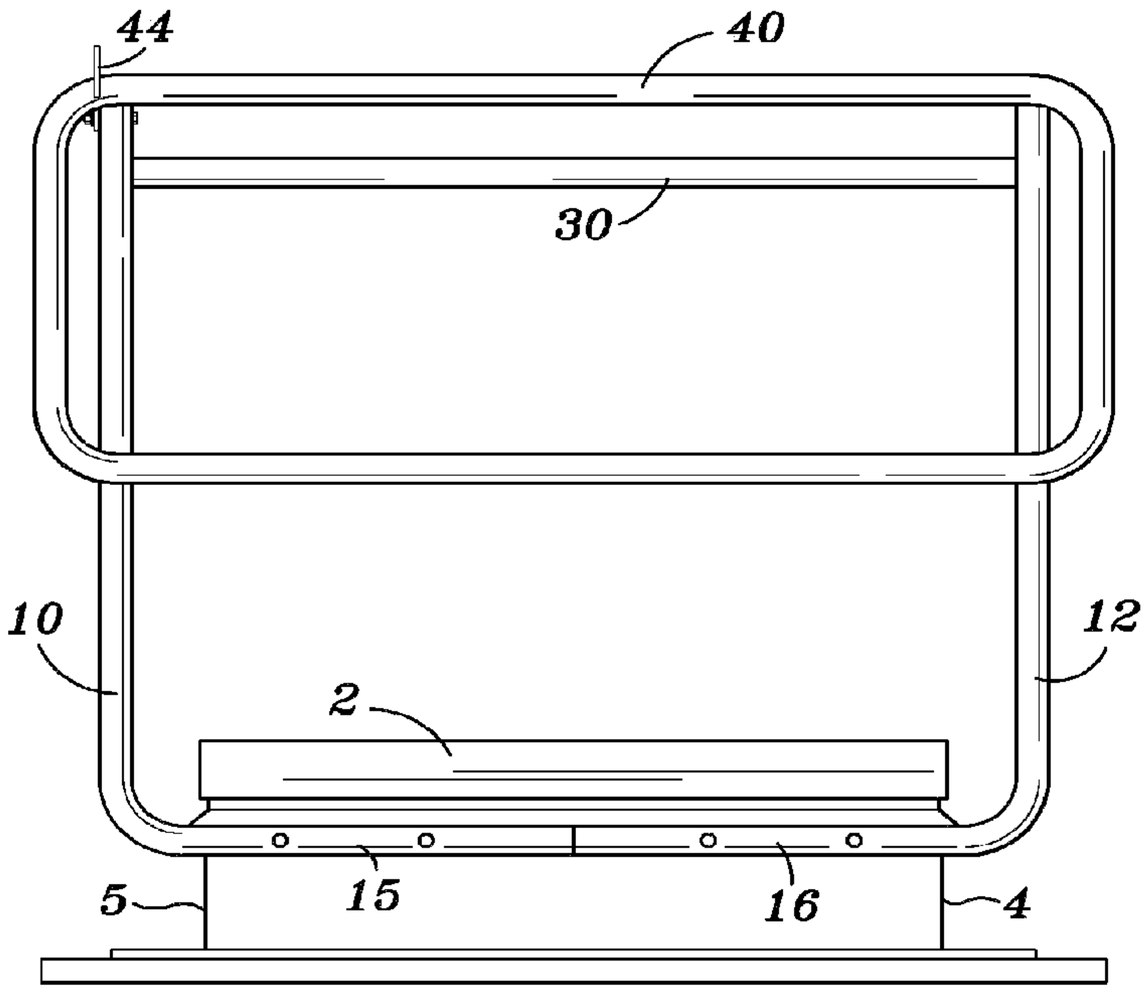

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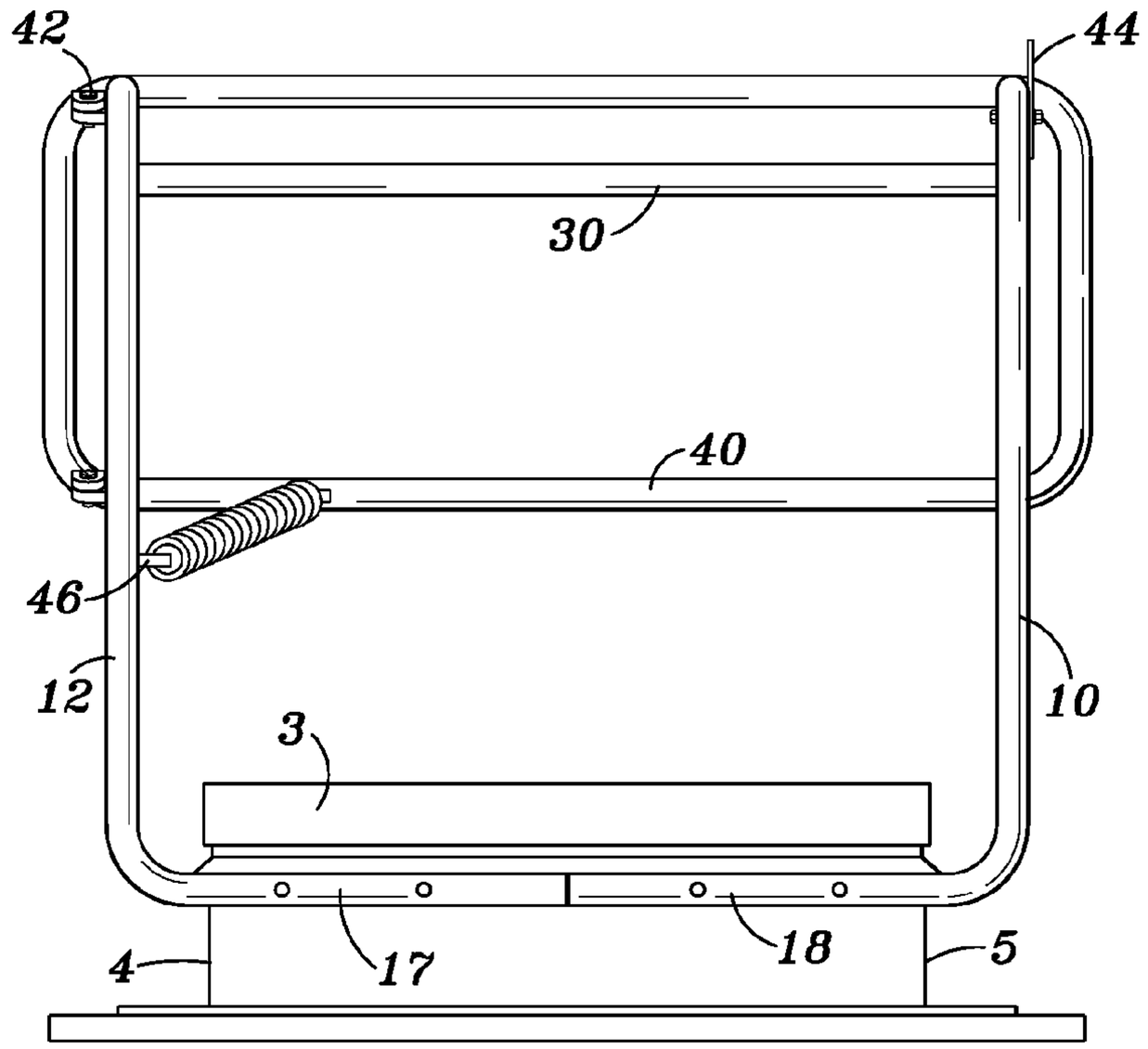

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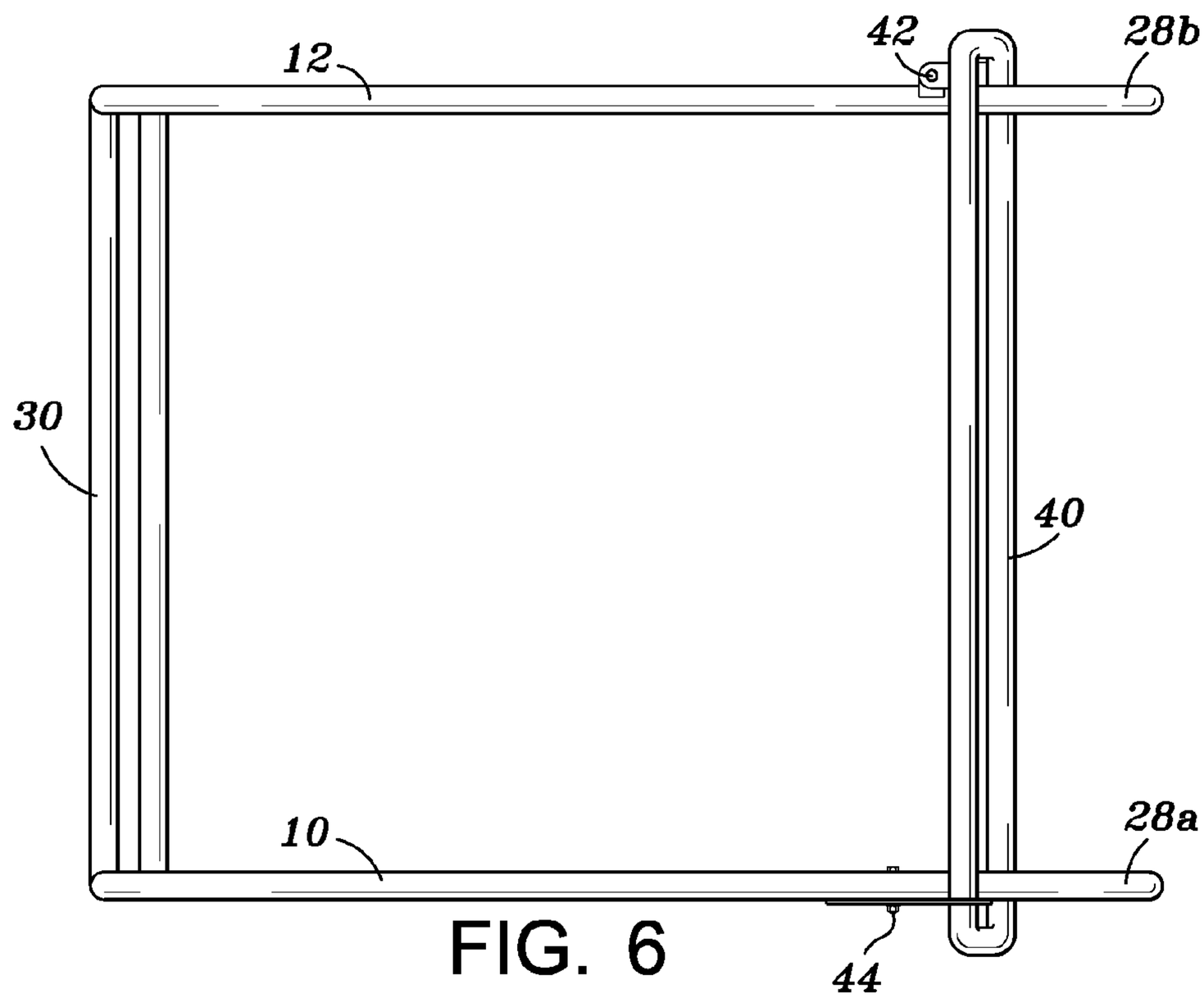

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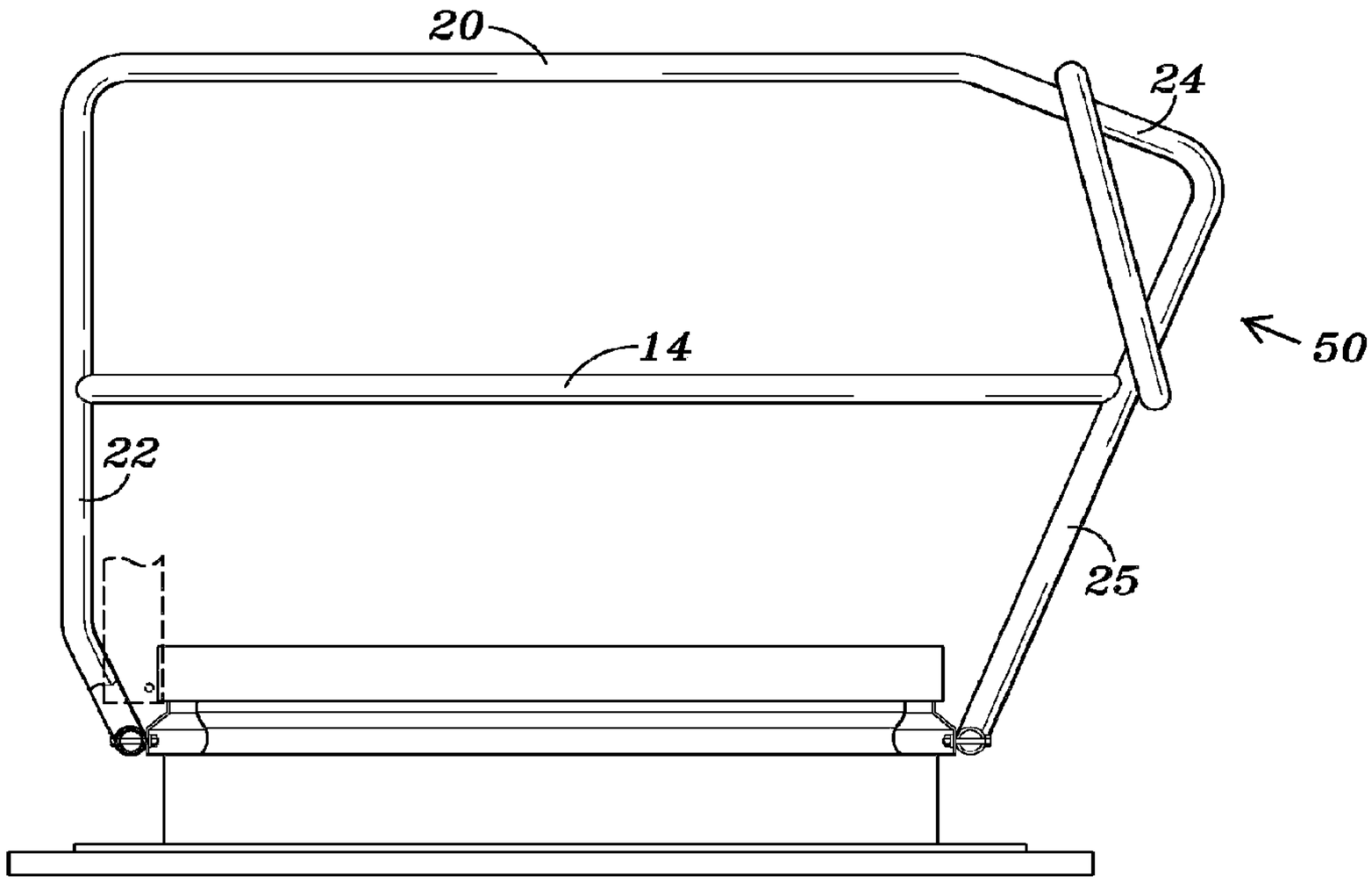

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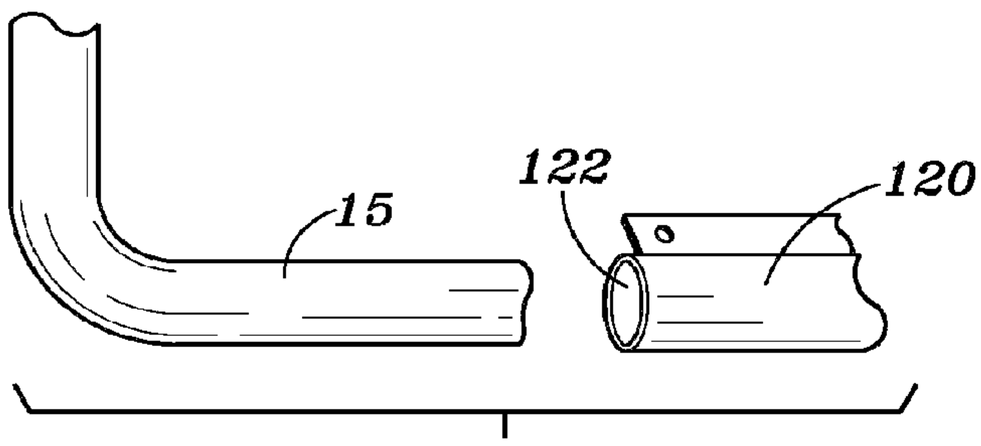

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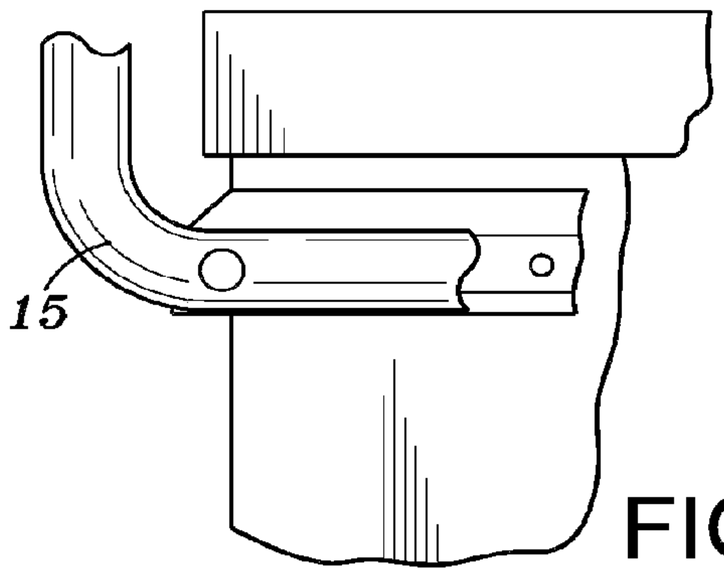

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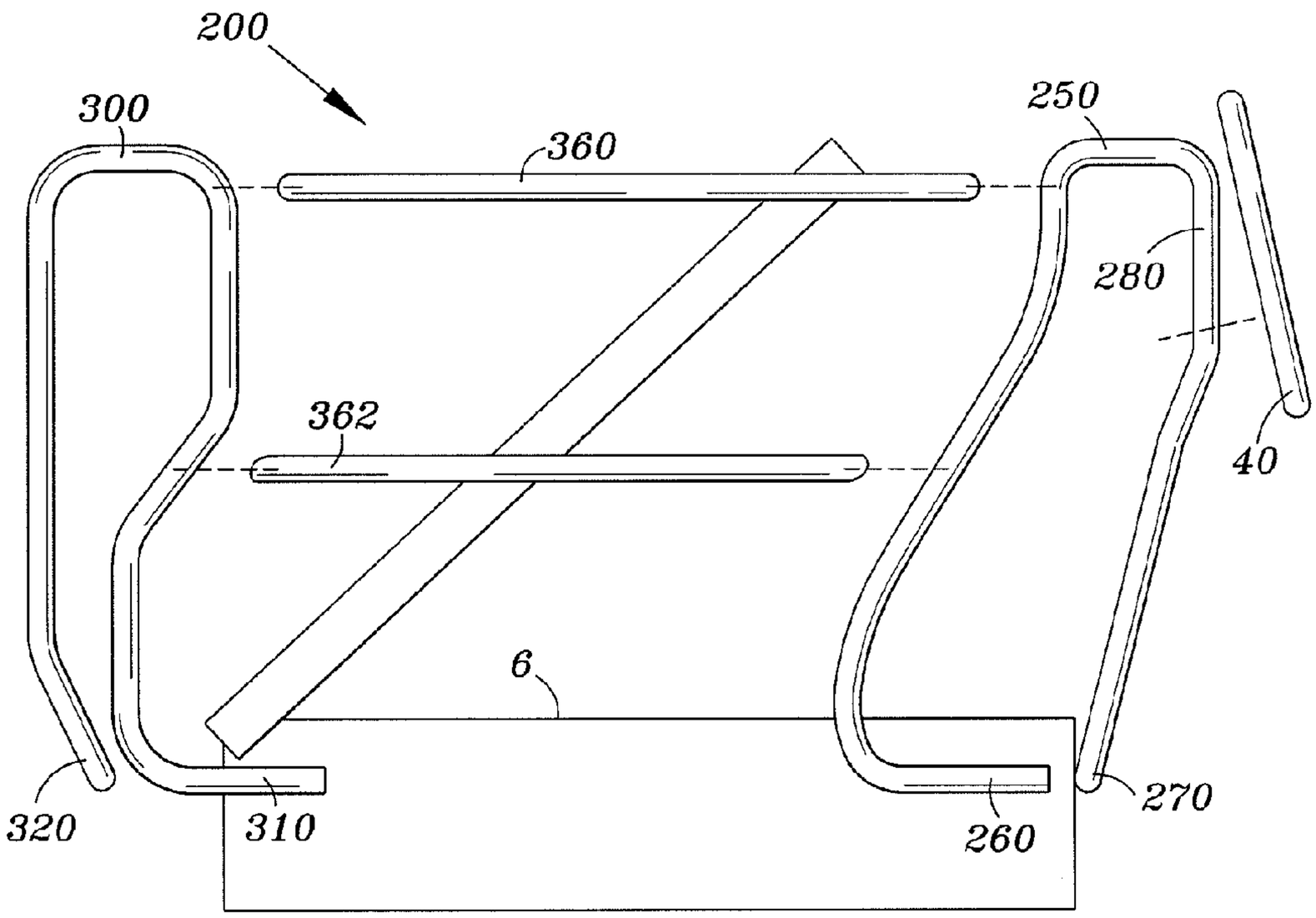
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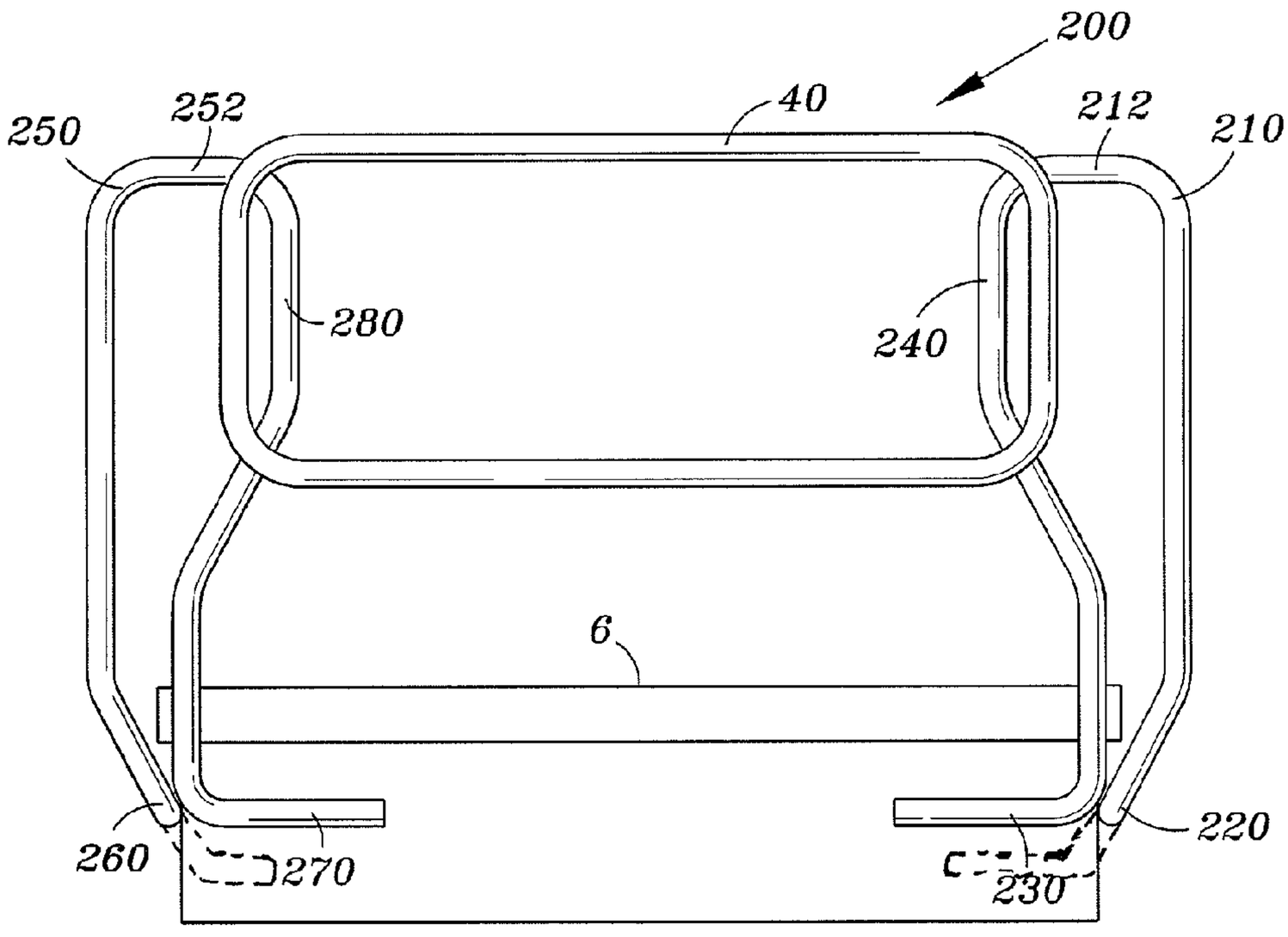
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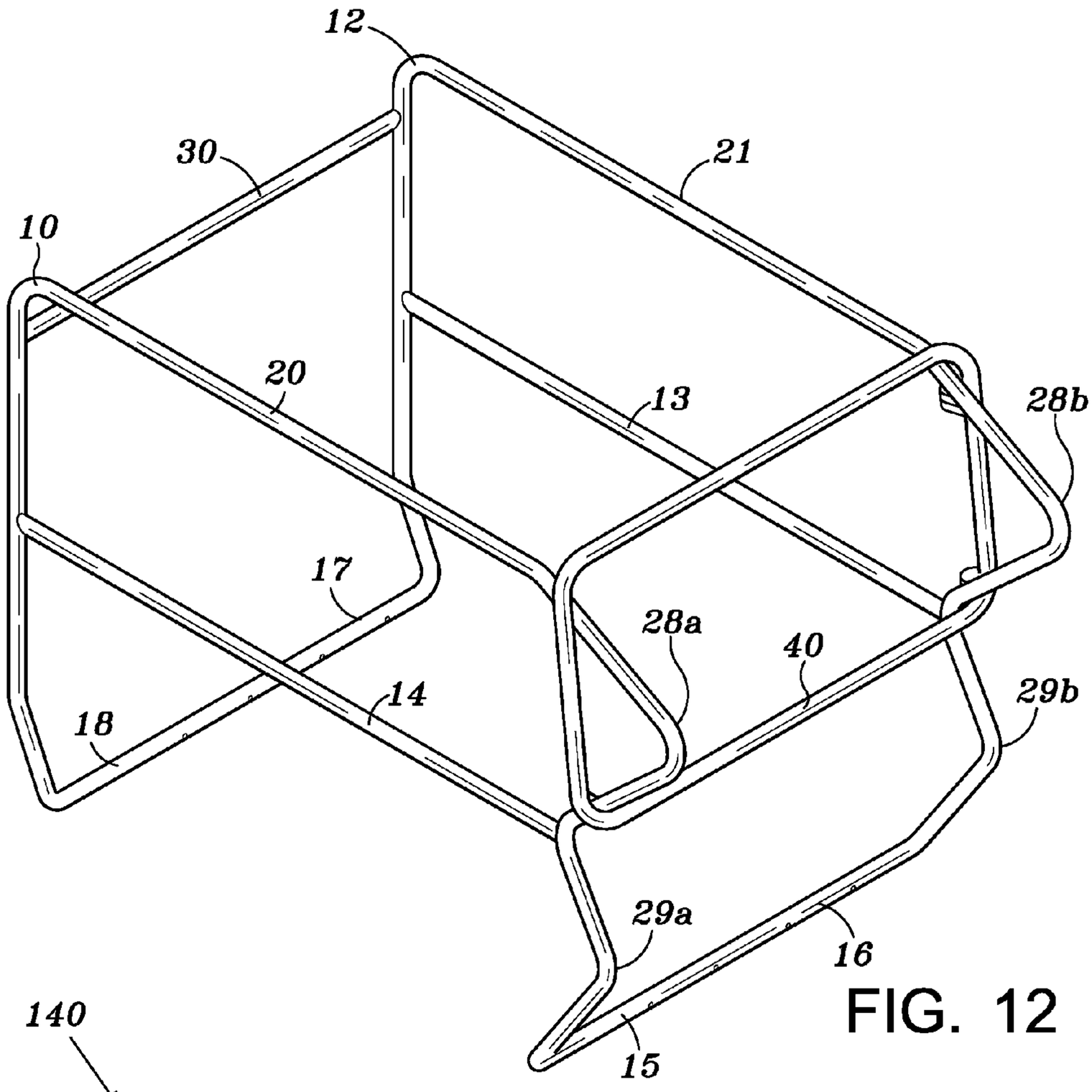
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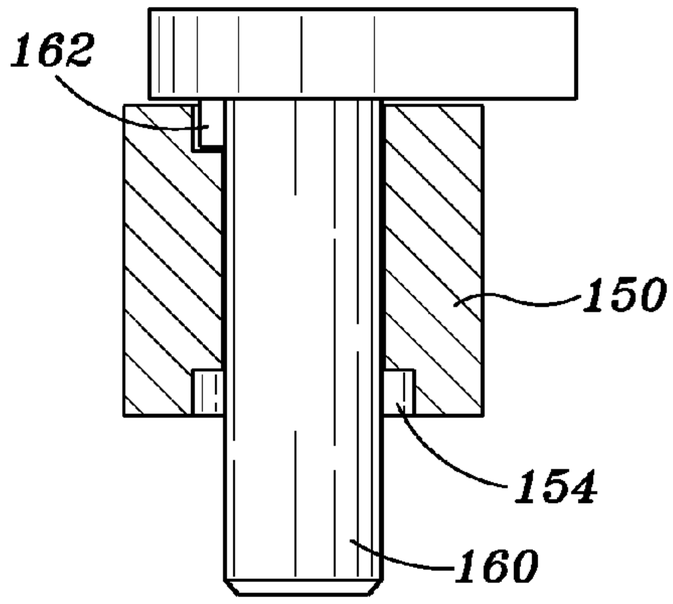
FIG. 12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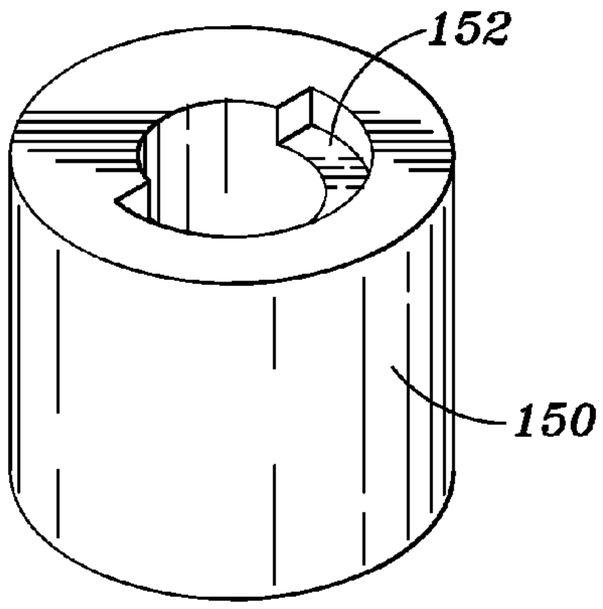

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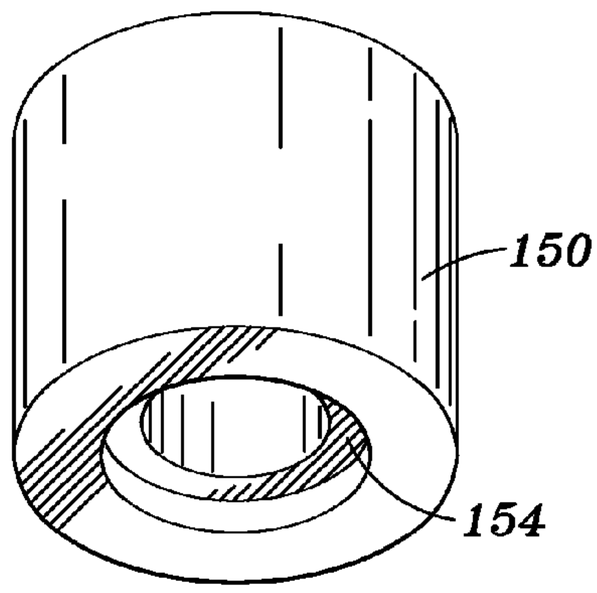


FIG. 15

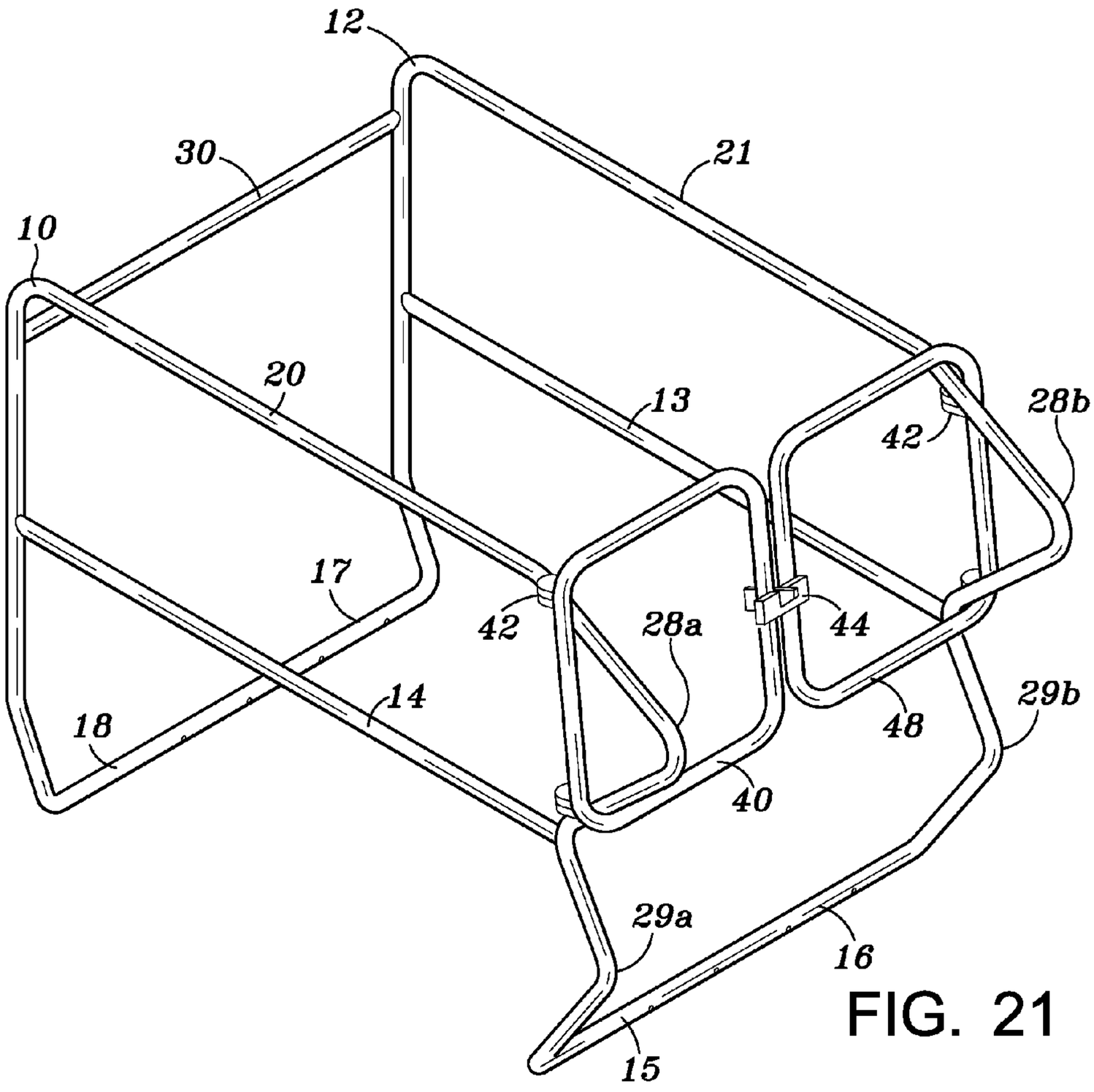
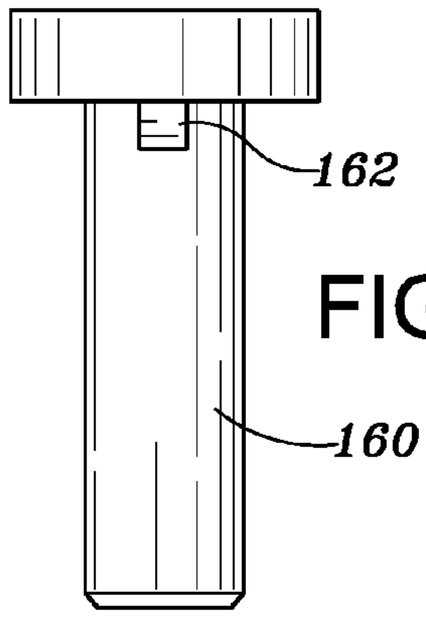


FIG. 21



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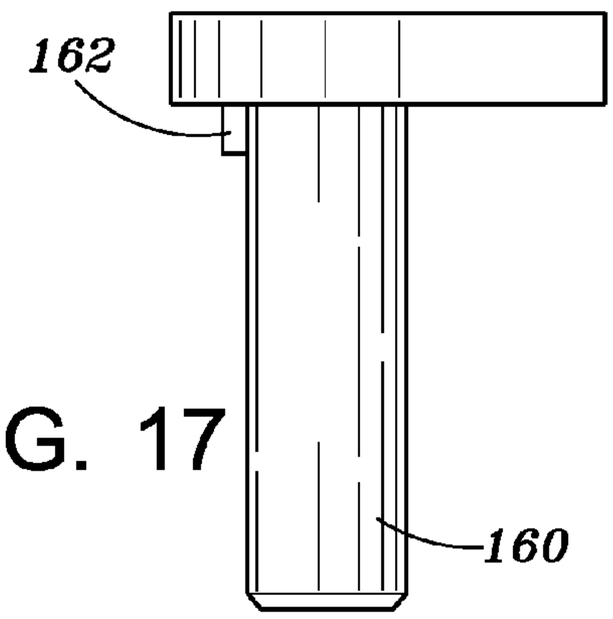

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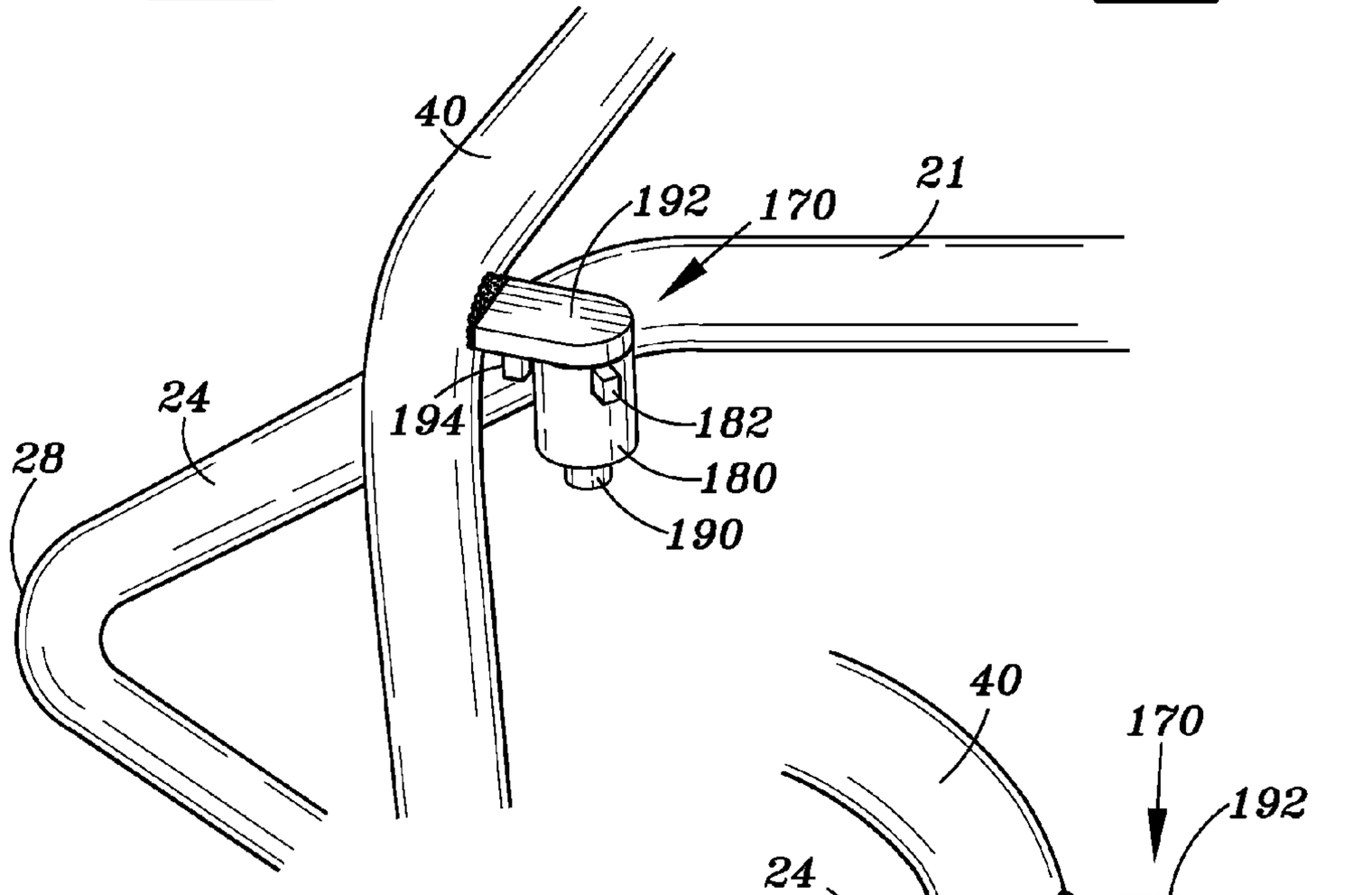

FIG. 18

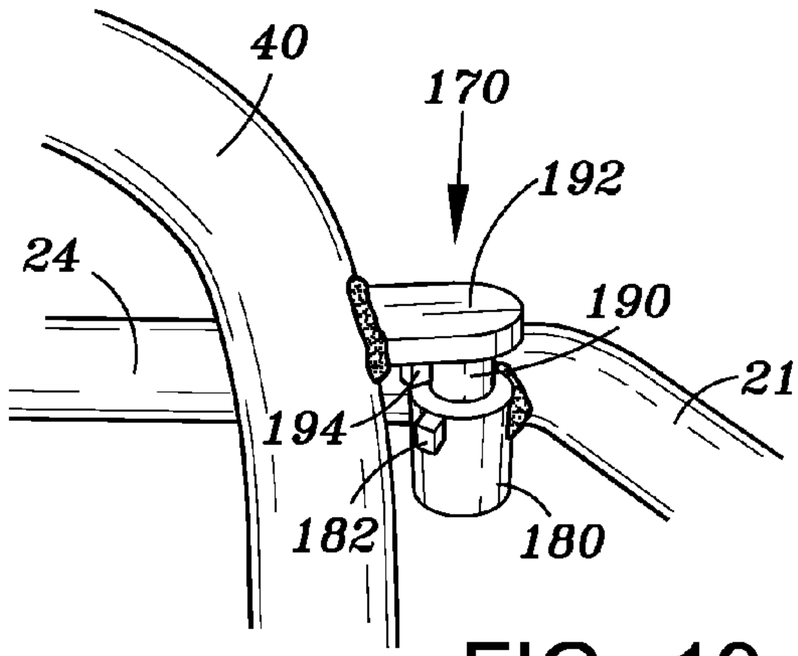

FIG. 19

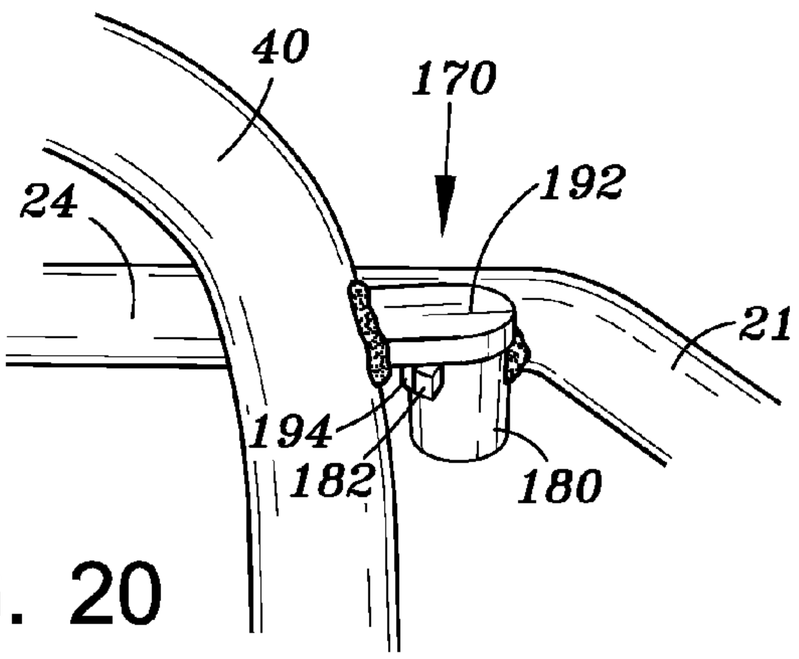

FIG. 20

INTEGRATED SAFETY RAIL PROTECTION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

Pursuant to 35 U.S.C. §120, this application is a continuation of U.S. patent application Ser. No. 12/825,265, entitled "Integrated Safety Rail Protection System," filed Jun. 28, 2010, and naming Richard J. Whiting as the inventor, which claims priority to, and the benefit of, U.S. Provisional Application No. 61/269,593, filed Jun. 26, 2009, entitled "Integrated Safety Rail Protection System," naming Richard J. Whiting as the inventor, all of which are hereby incorporated by reference for all purposes.

TECHNICAL FIELD

This invention relates to roof and floor safety protection rail systems and ergonomical methods of safe ingress and egress to reduce or eliminate hazards to personnel, including protection of people above and below a scuttle hatch, access ports, skylights and elevated decks.

BACKGROUND

While it is of the most importance for personnel to egress and ingress through an access portal in a safe manner it is also important for building owners and proprietors to reduce loss and liability. The act of climbing to or from an elevated height to egress or ingress a roof scuttle hatch, floor opening, skylight, or other elevated portal is often a very dangerous undertaking. Numerous hazards can cause an employee to trip, slip, or fall. In fact records with U.S. Department of Labor Occupational Safety & Health Administration (OSHA) show tragic accidents that often result in death. Occupational fatalities caused by falls remain a serious public health problem throughout the United States. According to the United States Department of Labor News report of Oct. 31, 2007 reported, in the Washington, D.C. metropolitan area, falls to a lower level was the most frequent type of fatal occupational injury; this was also true in New York, Chicago, Los Angeles, Miami, and Boston.

Personnel having a need to ascend or descend through an access portal, which usually requires a climb to an unsafe height above a floor or deck, face numerous safety concerns. For example, the location of an access portal is most often in a darkened and out of the way location within a building subsequently making it very difficult for personnel to see during exit. Further, due to the often dark indoor lighting near the portal, which is often above a drop ceiling, ascending personnel that have become accustomed to low light levels may be suddenly exposed the bright sunlight making if difficult to visualize a good secure grab hold. Moreover, while personnel are descending or exiting from the bright sunlight of the outdoors into the dark area adjacent to the portal, they may be suddenly exposed to low light levels further impairing their vision to secure a good grab hold while descending.

Flat roofed buildings, roadways, catwalks, attics, skylights, and other similar structures, commonly include portals, such as a roof portal, manhole, or other similar structure, with or without a hatch or lid, for ingress and egress to the roof, roadway, catwalk, etc. For example, commercial warehouses or other flat roofed buildings, commonly include one or more hatch-like roof portals for ingress and egress to the roof. Many times, these roof portals are located

in positions away from walls or other supporting structures, thereby, necessitating the user to make steep climbs over high elevations for ingress and egress to the roof. With high elevations and steep climbs the risk of harm to a user from a fall is already great; however, when factoring in a user's fear of heights, vertigo, or other emotional and/or physiological responses, the risk of harm to the user from falling greatly increases. Moreover, additional factors, such as transporting equipment through the portals, may further increase the risk of harm to the user.

A problem existing with current portals, such as a roof or scuttle hatch, without a safety rail and or grab holds is that personnel have to precariously perch on the top rung of a ladder with the only hand hold approximately 1 foot above their feet on the top of the portal's curb in order to exit or enter the portal, which is a rather difficult and dangerous balancing act that subjects the personnel to increased risk of harm.

Additional problems exists while ascending or descending, such as personnel often have to dangerously reach backwards with one hand while awkwardly holding on with the other hand to the portal's curb or top ladder rung to open or close an often heavy portal/hatch cover, which may or may not have worn or damaged spring load assist or latches, and may be subject to constant or changing wind loads while being opened or closed.

SUMMARY

Embodiments of the integrated safety rail protection system may utilize an ergonomic and structurally rigid railing system, which may include a gate, that provides the user with multiple ergonomic projections for hand and/or foot support while ingressing or egressng through a portal, such as a roof portal or other portal opening.

In accordance with one aspect of the present invention, a railing system that may be positioned on a roof adjacent to a roof opening portal having an upwardly lifting lid is provided and includes a first side rail with a first side gate projection, a second side rail with a second side gate projection; and a hinged gate operable to open outwardly.

In yet another embodiment of the integrated safety rail protection system, the railing system further comprises a back rail positioned substantially between the first side rail and the second side rail.

In yet another embodiment of the integrated safety rail protection system, the hinged gate interfaces with the first side gate projection.

In yet another embodiment of the integrated safety rail protection system, the hinged gate may interface with the second side gate projection.

In yet another embodiment of the integrated safety rail protection system, the railing system further comprises a hinge structure positioned adjacent to the interface of the hinged gate and the first side gate projection.

In yet another embodiment of the integrated safety rail protection system, the railing system further comprises a biasing structure positioned adjacent to the interface of the hinged gate and the first side gate projection.

In yet another embodiment of the integrated safety rail protection system, the railing system further comprises a latching structure positioned adjacent to the interface of the hinged gate and the second side gate projection.

In yet another embodiment of the integrated safety rail protection system, the first side rail further comprises a first side hand-grip projection.

In yet another embodiment of the integrated safety rail protection system, the second side rail further comprises a second side hand-grip projection.

In yet another embodiment of the integrated safety rail protection system, the rails system is at least partially knurled.

In yet another embodiment of the integrated safety rail protection system, the first side rail further comprises a cross rail member.

In yet another embodiment of the integrated safety rail protection system, the second side rail further comprises a cross rail member.

In yet another embodiment of the integrated safety rail protection system, the first side rail is formed from a single continuous tube.

In yet another embodiment of the integrated safety rail protection system, the second side rail is formed from a single continuous tube.

In yet another embodiment of the integrated safety rail protection system, the hinged gate is formed from a single continuous tube.

In yet another embodiment of the integrated safety rail protection system, the railing system further comprises a second hinged gate.

In yet another embodiment of the integrated safety rail protection system, the first hinged gate interfaces with the first side rail and the second hinged gate interfaces with the second side rail.

In yet another embodiment of the integrated safety rail protection system, the first hinged gate interfaces with the second hinged gate at a position between said first side rail and said second side rail.

In yet another embodiment of the integrated safety rail protection system, the railing system further comprises a latching structure positioned adjacent to at least one of the interface of said first hinged gate and said second hinged gate.

In yet another embodiment of the integrated safety rail protection system, the railing system further comprises a hinge structure positioned adjacent to the interface of the second hinged gate and the second side gate projection.

In yet another embodiment of the integrated safety rail protection system, the railing system further comprises a biasing structure positioned adjacent to the interface of the second hinged gate and the second side gate projection.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an isometric view showing one embodiment of the integrated safety rail protection system mounted onto a portal;

FIG. **2** is a side view showing one embodiment of the integrated safety rail protection system mounted onto a portal and having a latch structure;

FIG. **3** is a side view showing one embodiment of the integrated safety rail protection system, wherein the rail system is mounted to the portal using fasteners;

FIG. **4** is a front view showing one embodiment of the integrated safety rail protection system mounted onto a portal and having a latch structure;

FIG. **5** is a back view showing one embodiment of the integrated safety rail protection system mounted onto a portal and having a hinge structure, biasing structure, and a latch structure;

FIG. **6** is a top view showing one embodiment of the integrated safety rail protection system;

FIG. **7** is a side view showing one embodiment of the integrated safety rail protection system mounted onto a portal with an alternative hand grip projection;

FIG. **8** is a partially exploded side view showing one embodiment of the integrated safety rail protection system utilizing corner rails;

FIG. **9** is a front view showing embodiments of the integrated safety rail protection system of FIG. **8** utilizing corner rails;

FIG. **10** is an exploded front view showing one embodiment of a rail mounting system having a hollow mounting structure;

FIG. **11** is a front view showing one embodiment of a rail mounting system that mounts the integrated safety rail protection system to a portal using fasteners, such as screws or bolts;

FIG. **12** is an isometric view showing one embodiment of a rail mounting system prior to installation of the rail mounting system;

FIG. **13** is a side cutaway view of one embodiment of a pinchless hinge structure;

FIG. **14** is a top isometric view of a housing of a pinchless hinge structure having a partial recess in one end of the housing;

FIG. **15** is a bottom isometric view of a housing of a pinchless hinge structure having a full recess in one end of the housing;

FIG. **16** is a front view of a hinge shaft of a pinchless hinge structure having a protrusion on the hinge shaft;

FIG. **17** is a side view of a hinge shaft of a pinchless hinge assembly having a protrusion on the hinge shaft;

FIG. **18** is an isometric view of an external stop hinge structure interfacing a side rail and a gate in a manner where the external stop will engage to prevent further movement of the gate;

FIG. **19** is an isometric view of an external stop hinge structure interfacing a side rail and a gate in a manner where the hinge shaft has been raised to allow the shaft to freely rotate;

FIG. **20** is an isometric view of an external stop hinge structure interfacing a side rail and a gate in a manner where the external stop is engaged; and

FIG. **21** is an isometric view showing one embodiment of the integrated safety rail protection system having a first and a second gate.

DETAILED DESCRIPTION

It should be understood at the outset that although an exemplary implementation of the present invention is illustrated below, the present invention may be implemented using any number of techniques, materials, designs, and configurations whether currently known or in existence. The present invention should in no way be limited to the exemplary implementations, drawings, and techniques illustrated below, including the exemplary designs and implementations illustrated and described herein.

In the description which follows, like parts are marked throughout the specification and drawings with the same reference numerals, respectively. The drawings are not necessarily to scale and certain features may be shown exaggerated in scale or in somewhat schematic form in the interest of clarity and conciseness.

Referring initially to FIGS. **1**, **2**, **4**, **5**, **6**, and **12**, an embodiment of the integrated safety rail protection system **1** is provided and includes, in one form, a first substantially vertical side rail **10**, a second substantially vertical side rail

12, and a hinged gate 40. It should be noted that the second side rail 12 operates and functions in substantially the same manner as the first side rail 10, as further described herein. In other embodiments, a side rail 10 may have a cross rail member 14 extending longitudinally or diagonally within a plane passing through the side rail. In yet other embodiments, a back rail member 30 may extend between the first side rail 10 and the second side rail 12, at a location generally adjacent to the opposite end from the gate portion of the integrated safety rail protection system 1, but in other embodiments the back rail member 30 may extend between the first side rail 10 and the second side rail 12, at a location anywhere suitable along the length of the side rails (10 and 12).

Referring to FIGS. 1 and 2, in other embodiments, a side rail 10 may have a generally horizontal top rail 20 for structural strength and to provide the user with a gripping surface for aiding in ingress and egress through a portal 6, such as a roof portal. The side rail 10 may further have a generally vertical down rail 22 for structural strength and to provide the user with a gripping surface for aiding in ingress and egress through the portal 6. In yet another embodiment, the side rail 10 may further have a side gate projection 28 for structural strength, to interface with the hinged gate 40, and to provide the user with an ergonomic gripping surface for aiding in ingress and egress through the portal 6. In yet another embodiment, the side rail 10 may further have a side hand-grip projection 29 for structural strength and to provide the user with an ergonomic gripping surface for aiding in ingress and egress through the portal 6. In yet other embodiments, the side gate projection 28 and the side hand-grip projection 29 may have the form of straight and curved lengths with arcuate bends of varying angles. For example, in some embodiments, as seen in FIG. 2, the front portion of the side rail 10, may have a first segment 24, extending from the top rail 20 at a downward angle of about 25-degrees from the top rail 20, transitioning to a second segment 25, extending from the first segment 24 at downward angle of about 135-degrees from a line substantially parallel to the top rail 20, wherein the combination of the first segment 24 and second segment 25 form the front side gate projection 28, transitioning to a third segment 26, extending downward from the second segment 25 at a downward angle of about 60-degrees from a line substantially parallel to the top rail 20, transitioning to a fourth segment 27, extending from the third segment 26 at a downward angle of about 125-degrees from a line substantially parallel to the top rail 20, wherein the combination of the third segment 26 and fourth segment 27 form the front hand-grip projection 29. Alternatively, in other embodiments as illustrated in FIG. 7, and described in more detail below, the first segment 24 may transition to a second segment 25 at a downward angle of about 120-degrees from a line substantially parallel to the top rail 20, wherein the combination of the first segment 24 and second segment 25 form the front side gate projection 50, and wherein the second segment 25 extends downward to the base of the side rail 10. The embodiments of the front side gate projections and hand-grip projections are not limited to the angles described, but as one of ordinary skill in the art would recognize, can be composed of any number of segments at any number of angles to achieve one or more ergonomic or desired grab holds or hand-grips for a user.

In yet other embodiments, the side rail 10 may be made from a single length of metallic tubing that is bent to form a one piece side rail 10 to provide the added benefit, in certain embodiments, of ease of manufacture, ease of assembly, structural strength, and no loosening of joint fittings. However, in yet other embodiments, the side rail 10 may be crafted from multiple pieces of tubing or other suitable material fastened together, via bolts, welds, screws, or other suitable means. Additionally, in other embodiments the side rail 10 may further include a cross rail member 14 to aid in structural strength and provide the user with an additional gripping surface for aiding in ingress and egress through the portal 6.

Referring to FIGS. 1, 3, 4, 5, 11, and 12, in other embodiments, the side rail 10 may have a front mounting projection 15 for fastening, via screws, bolts, welds, or other suitable means, the rail 10 to the front flange 2, and side rail 10 may have a rear mounting projection 18 for fastening, via screws, bolts, welds, or other suitable means, the rail 10 to the rear flange 3 of the portal 6, although in other embodiments, the front mounting projection 15 and the rear mounting projection 18 may be positioned for mounting the side rail 10 to the side flange 5. However, fastening to the front flange 2 and rear flange 3 of a portal 6 provides the benefit of strengthening the capability of the side rail 10 to withstand side-to-side and front-to-back forces that might cause railing systems to fail or otherwise separate from their mountings under the stress of a user's weight.

Referring to FIG. 10, in other embodiments, a mounting projection 15 may be mounted adjacent to the portal 6 using a mounting structure 120 having an opening 122 for receiving the mounting projection 15, which may be fastened to the mounting structure 120, via screws, bolts, welds, or other suitable means, and which the mounting structure 120 itself is mounted adjacent to the portal 6, via screws, bolts, welds, or other suitable means. The opening 122 of the mounting structure 120 may be a hollow or tubularly shaped opening, or other suitable opening for receiving the mounting projection 15. For example, in one embodiment, the mounting structure 120 may be a hollow metal tube with protruding surfaces for attaching the mounting structure 120 to the front flange 2 or rear flange 3 of the portal 6, wherein a mounting projection 15 may be inserted into the hollow portion of the metal tube and fastened therein using welds, bolts, screws, or other suitable means. The mounting structure 120 may be made from metal, fiberglass, composite, or other suitable materials, and allow for quick and easy attachment adjacent to the portal 6 or ground surface, allow for flexibility in fitting the railing system to various sized portals 6, and allow for increased strength and rigidity by providing more contact surface to the mounting projection 15 than might be accomplished using traditional direct fastening, via screws, bolts, or welds, of the mounting projection 15 adjacent to the portal 6.

Referring to FIGS. 2, 4, 5, 6, 7, and 12, in one embodiment, the hinged gate 40 is positioned to rest adjacent to the side gate projection 28*a* of the first side rail 10 and the side gate projection 28*b* of the second side rail 12 and operable to open outwardly from the portal 6 and return to its resting or closed position (i.e., interfaced with both the side gate projection 28*a* of the first side rail 10 and the side gate projection 28*b* of the second side rail 12) via gravity, as shown in FIGS. 1 and 12. In some embodiments, the hinged gate 40 is rectangular in shape, although any suitable shape, such as square, oval, circular, etc., may be used. In some embodiments, the hinged gate 40 may be made from a single length of metallic tubing that is bent to form a one piece side hinged gate 40, to provide the added benefit of ease of manufacture, ease of assembly, structural strength, and no loosening of joint fittings. However, in yet other embodiments, the hinged gate 40 may be crafted from multiple pieces of tubing or other suitable material, fastened together,

via bolts, welds, screws, or other suitable means. In yet other embodiments, the hinged gate **40** may comprise segments that may telescope fully or partially within adjacent segments, or utilize spacers between the segments, to allow for a gate having adjustable dimensions to accommodate the installation of the rail system **1** adjacent to portals **6** of various sizes. In some embodiments, the hinged gate **40** includes a recess or projection for mating with a projection or recess of one of the side gate projection **28***a* of the first side rail **10** and the side gate projection **28***b* of the second side rail **12** to form a hinge upon which the hinged gate **40** may swing outwardly from its resting position. In yet other embodiments, as illustrated in FIGS. **5** and **6**, a hinge structure **42** may be used to interface the hinged gate **40** with of one of the side gate projection **28***a* of the first side rail **10** and the side gate projection **28***b* of the second side rail **12** to allow the hinged gate **40** to swing outwardly from its resting position. In yet other embodiments, as illustrated in FIGS. **2**, **4**, **5**, and **6**, a latch structure **44** may be used to latch the hinged gate **40** to of one or both of the side gate projection **28***a* of the first side rail **10** and the side gate projection **28***b* of the second side rail **12**, which provides added security from the wind or users accidentally opening the hinged gate **40** at a time when opening of the hinged gate **40** is not intended. Such a latching mechanism may be a simple hook and loop, such as the gravity rocker latch illustrated in FIG. **2**, magnetic, or other suitable latching means positioned in any of a variety of positions.

In yet other embodiments, as illustrated in FIG. **5**, a biasing structure **46** may be used to bias the hinged gate **40** to a side gate projection **28** of the first side rail **10** or the second side rail **12**, which, alone or in combination with gravity, causes the hinged gate **40** to rest in a closed position interfacing with the side gate projections **28** of the first side rail **10** and the second side rail **12**. The biasing structure **46** may be a spring, piston, or any other suitable means for influencing the movement of the hinged gate **40**. The use of a biasing structure **46** provides added security from the wind or users accidentally opening the hinged gate **40** at a time when opening of the hinged gate **40** is not intended. In other embodiments, the gravity operation of the gate functions by positioning the hinged gate **40** to rest adjacent to the side gate projection **28***a* of the first side rail **10** and the side gate projection **28***b* of the second side rail **12**, at an angle from vertical, as measured by at least one plane passing through the hinged gate **40** and the open volume enclosed by it, which in the preferred embodiment is an acute angle from vertical as measured from the lowermost point of reference of the hinged gate **40** as the apex of the angle with vertical. This creates the situation where the hinged gate **40** swings outward from its interface with one of the side gate projection **28***a* of the first side rail **10** and the side gate projection **28***b* of the second side rail **12** at an angle offset from vertical, thereby, causing the hinged gate **40** to return to its resting position or closed position via the force applied by gravity to its mass. Such a gravity gate feature provides the added benefit of having the gate automatically close or biased to close when not in use, thereby eliminating or reducing the safety concern of a user forgetting to close the gate and risking a fall by a user therethrough. It should be noted that in other embodiments, the hinged gate **40** may interface directly with the side rails **10** and **12** or any portion of the side rails **10** and **12** as opposed to the side gate projections **28***a* and **28***b*. In yet other embodiments, the hinged gate **40** is restricted, via the hinge, side gate projections, or other mechanical block, from opening in an inward direction towards the area formed between the first side rail **10** and the second side rail **12** and/or substantially over the opening of the portal **6**. In yet other embodiments, the hinged gate **40** is restricted, via the hinge, side gate projections, or other mechanical block, from opening in an outward direction past a point that would prohibit the return of the gate **40** to its resting or closed position via gravity.

Referring to FIGS. **13**, **14**, **15**, **16**, and **17**, in yet other embodiments, the hinge structure **42** of FIGS. **5**, **6**, and **21** may be a pinchless hinge structure **140** that can be attached to the structures to be hinged by weld, bolt, or other means. The hinge structure **140** of these embodiments comprises a hinge housing **150**, a hinge shaft **160**, a hinge shaft protrusion **162**, and a partial hinge housing recess **152** on one end of the housing **150**. In operation, when the shaft is inserted into the pinchless hinge structure **140**, the rotation of the shaft is impeded by the interface of the shaft protrusion **162** with the partial housing recess **152**; however, by simply raising the shaft **160** in relation to the housing **150**, the shaft protrusion **162** can be moved to clear the impediment of the partial housing recess **152**, and thus, the shaft **160** can fully rotate within the housing **150**. Other embodiments may further include a full 360 degree hinge housing recess **154** in one end of the housing **150** to allow for free rotation of the hinge shaft **160** despite the inclusion of a hinge shaft protrusion **162**. In other embodiments, the hinge structure **140** can be opened and closed by an internal or external spring, torsion bar, or other powered device via a splined shaft/gear mechanism or other suitable means, as one of ordinary skill in the art would understand.

Referring to FIGS. **18**, **19**, and **20**, in yet other embodiments, the hinge structure **42** may be an external stop hinge structure **170** that can be attached to the structures to be hinged by weld, bolt, or other means. The hinge structure **170** of these embodiments comprises a hinge housing **180**, a hinge shaft **190**, a hinge shaft cap **192**, a housing protrusion **182**, and a hinge cap protrusion **194**. The hinge shaft **190** is attached to the hinge shaft cap **192**, which has the hinge cap protrusion **194** attached thereto. The hinge shaft **190** is inserted into an opening formed within the hinge housing **180** for receiving the hinge shaft **190** for rotation. The hinge cap protrusion **194** interfaces with the housing protrusion **182**, which is attached to the exterior of the hinge housing **180**, said interface limits the degree of rotation of the hinge shaft **190** within the hinge housing **180**. In other embodiments, the hinge shaft **190** may be raised in elevation relative to the hinge housing **180**, thereby eliminating any interference between the hinge cap protrusion **194** and the hinge housing protrusion **182**, which allows for full 360 degree rotation of the hinge shaft **190** within the hinge housing **180**. In other embodiments, the hinge structure **170** can be opened and closed by an internal or external spring, torsion bar, or other powered device via a splined shaft/gear mechanism or other suitable means, as one of ordinary skill in the art would understand.

Referring to FIG. **21**, in yet another embodiment, a second hinged gate **48** is included in the safety rail system **1**. In this embodiment, the first hinged gate **40** interfaces with a first side gate projection **28***a*, although it may interface directly with any portion of the first side rail **10**. As previously described, the interface between the hinged gate **40** and the first side gate projection **28***a* may include projections and recesses or a hinge structure **42** for a hinge-type mating between the hinged gate **40** and the first side gate projection **28***a*. Additionally, in some embodiments, as previously described, a biasing structure may be included to influence the movement of the hinged gate **40** and the hinged gate may be positioned at an acute angle from vertical to utilize the

force of gravity for influencing the movement of the hinged gate **40**. The first hinged gate **40** does not directly interface with the second side gate projection **28***b* or any portion of the second side rail **12**; instead, the second hinged gate **48** is positioned, operates, and interfaces with the second side gate projection **28***b* or any portion of the second side rail **12** in a manner substantially similar to the position, operation, and interface between the first hinged gate **40** and the first side gate projection **28***a* or any portion of the first side rail **10**. In operation of one embodiment, portions of the first hinged gate **40** and the second hinged gate **48** interface at a point between the first side gate projection **28***a* and the second side gate projection **28***b*, and may include a latching mechanism **44** operable to latch the first hinged gate **40** to the second hinged gate **48**.

Referring again to FIG. **7**, in one embodiment of the integrated safety rail protection system, the side rail **10** may include a combination side gate projection and hand-grip projection **50**, comprising a first segment **24**, extending downward at an angle less than 180 degrees from the top rail **20**, and a second segment **25**, extending downward from the first segment **24** to interface with the portal **6**. In addition to the economic features of fewer bends in the railing system, some users find the straight lines ergonomically advantageous.

Referring to FIGS. **8** and **9**, in yet another embodiment, a corner rail system **200** is shown that may be positioned adjacent to a portal **6**, and comprises a front left corner rail **210** with a first front left corner mounting projection **220**, a second front left corner mounting projection **230**, and a front left corner gate projection **240**, wherein said first front left corner mounting projection **220** is positioned substantially perpendicular to said second front left corner mounting projection **230**, and wherein said front left corner gate projection **240** interfaces with the hinged gate **40**, for example where said front left corner gate projection **240** extends at least partially into the area enclosed by the gate **40**. The corner rail system **200** further comprises a front right corner rail **250** with a first front right corner mounting projection **260**, a second front right corner mounting projection **270**, and a front right corner gate projection **280**, wherein said first front right corner mounting projection **260** is positioned substantially perpendicular to said second front right corner mounting projection **270**, and wherein said front right corner gate projection **280** extends at least partially into the area enclosed by the gate **40**. The hinged gate **40** operates in the same fashion as described above in reference to the side rail system **1**. In some embodiments, the front left corner rail **210** and the front right corner rail **250** may each have a generally horizontal top rail (**212** and **252**, respectively) for an ergonomic grab hold. In yet other embodiments, the front left corner gate projection **240** may extend from the top rail **212**, and the front right corner gate projection **280** may extend from the top rail **252**. The remaining structure associated with the front left corner rail **210** and the front right corner rail **250** may take on various forms, including, as described above in reference to the side rail system **1**, straight structures and angled structures that provide ergonomic or desired grab holds or hand-grips. In some embodiments, as with the side rail **10** of the rail system **1**, the front left corner rail **210** and the front right corner rail **250** can each be formed from a continuous tube of metal, although other materials, such as fiberglass, composite, carbon fiber, etc., may also be used. The benefit of using a continuous tube or other continuous structure is its strength and rigidity as well as ease of manufacture. In yet other embodiments, as with the side rail **10** of the rail system **1**, the front left corner rail **210** and the front right corner rail **250** can each be formed from segments of metal tubing or other suitable materials, such as fiberglass, composite, carbon fiber, etc., that fastened together by screws, bolts, welds, or other suitable fastening means.

Referring again to FIG. **8**, in yet other embodiments of the corner rail system **200**, the system **200** may further comprise a back right corner rail **300** with a first back right corner mounting projection **310** and a second back right corner mounting projection **320**, wherein said first back right corner mounting projection **310** is positioned substantially perpendicular to said second back right corner mounting projection **320**. In yet other embodiments, a back left corner rail **350** (not illustrated) may be used that operates in the substantially same manner as the back right corner rail **300** as described above.

In yet another embodiment, a back rail member **352** (not illustrated), such as a metal tube or other structure of suitable size, shape and material, is mounted between the back right corner rail **300** and the back left corner rail **350** (not illustrated) for enhanced stability between the two corner rails, and to provide yet another grab hold or hand grip for the user. Because the corner rail system **200** may accommodate portals of various lengths and widths, in a kit or retrofit form, the back rail member may be supplied in a manner to be cut down to desired length for installation of the portal at issue.

Referring again to FIG. **8**, in yet another embodiment, a cross rail member **360** may be mounted between the front right corner rail **250** and the back right corner rail **300** for enhanced stability between the two corner rails, to lessen the risk of a user falling between the rails, and to provide yet another grab hold or hand grip for the user. In yet another embodiment, a cross rail member **360** may be mounted between the front left corner rail **210** and the back left corner rail **350** in the same fashion and with the same benefits as previously described. Because the corner rail system **200** may accommodate portals of various lengths and widths, in a kit or retrofit form, the cross rail member may be supplied in a manner to be cut down to desired length for installation of the portal at issue.

In yet another embodiment, the corner rail system **200** may include a single corner rail **210** for mounting adjacent to a portal **6**. Such a single corner rail system may be used where multiple corner rail systems are cost prohibitive, but at least some ergonomic and sturdy grab holds or hand-grips are desired.

Referring again to FIGS. **8** and **9**, by having the mounting projections, for example mounting projections **260** and **270**, of the corner rails (front or back) at substantially right angles to one another, easy mounting (via screws, bolts, welds, or other suitable fastening means) of the corner rails adjacent to a portal **6** may occur, since many portals have 90-degree corners that easily, or with minimal adjustment, match up to the substantially perpendicular mounting projections. An additional benefit of substantially perpendicular mounting projections is that the respective corner rail may have enhanced stability, when mounted, against forces acting on the corner rail from all sides. If the mounting area adjacent to the portal **6** does not have a ninety degree corner, the mounting projections may be adjusted, by bending, use of spacers, or otherwise, to accommodate the shape of the portal **6**. Additionally, in some embodiments, a mounting structure **120**, as described above and referred to in FIG. **10**, may be used to fasten a mounting projection, for example mounting projections **260** or **270**, to the portal **6**, for ease of mounting installation, adjustability in mounting the corner

rails (**210**, **250**, **300**, **350**) adjacent to portals **6** of various sizes, and strength of the mount due to increased surface area on the mounting projection. Absent use of a mounting structure **120**, the mounting projections are directly mounted adjacent to the portal **6** using screws, bolts, welds, or other suitable fastening means.

In yet other embodiments, a corner rail **210** (or any corner rail, including **250**, **300**, and **350**) may have only one mounting projection for mounting (via a mounting structure **120** or by screws, bolts, welds, or other suitable fastening means) to any side or portion of the portal **6** where the position of the corner rail **210** is desired. Referring again to FIGS. **8** and **9**, in yet other embodiments, a corner rail **210** (or any corner rail, including **250**, **300**, and **350**) may have a first mounting projection **220** and a second mounting projection **230**, where such mounting projections are parallel or substantially parallel to each other (as illustrated, for example, by the dashed lines of FIG. **9**) for ease of mounting and strength of the mount to any side, or front portion of the portal **6** where the position of the corner rail **210** is desired.

In yet another embodiment, the corner rail system **200** may be provided in kit form for retrofitting existing portals, such as roof openings, manholes, skylights, etc., wherein the kit may include a front left corner rail **210**, a front right corner rail **250**, and a hinged gate **40**. As described above, the hinged gate **40** may be adjustable in dimensions, with spacer segments, telescoping segments, etc., to accommodate varied widths of portals **6**. Such a system would provide substantial protection from a user falling during ingress or egress through the portal **6**, especially in light of the various shapes and angles of the grab holds or hand-grips. In yet another embodiment, the kit may include a back right corner rail **300** and/or a back left corner rail **350** to provide additional safety from a user falling during ingress or egress through the portal **6**. In yet other embodiments, the kit may include a back rail **352** for providing additional barriers between the corner rails to provide additional safety from a user falling during ingress or egress through the portal **6**. In yet other embodiments, the kit may include a top rail **360** for providing additional barriers between the corner rails to provide additional safety from a user falling during ingress or egress through the portal **6**. In yet other embodiments, the kit may include a cross rail **362** for providing additional barriers between the corner rails to provide additional safety from a user falling during ingress or egress through the portal **6**. In yet other embodiments, the kit may include one or more mounting structures **120** and/or mounting hardware, such as screws, bolts, etc.

It should be noted that the elements making up any chosen embodiment of the invention described herein may be made of metal, ceramics, plastics, carbon fiber, fiberglass, wood, and other materials with suitable properties. Additionally, all or selected portions of surfaces of the safety rail system **10** may be knurled for grip, which includes surface texturing, surface projections, textured paint or powder coating, textured grip tape, or any other method of surface texturing to aid in gripping by a user's hands or feet.

Although embodiments of the integrated safety rail protection system have been described in detail, those skilled in the art will also recognize that various substitutions and modifications may be made without departing from the scope and spirit of the appended claims.

What is claimed is:

1. A safety rail protection system adaptable to be positioned adjacent to a portal to aid in at least one of ingress and egress through the portal, the safety rail protection system comprising:

a hinged gate having an opening and first and second opposing members operable to provide a first gripping surface to aid in at least one of ingress and egress through the portal, the hinged gate operable to open outwardly from a closed position to an open position and being biased to return to the closed position after being placed in the open position;

a first side rail, wherein the first side rail includes a first side gate projection extending at least partially into the hinged gate opening and the first side rail interfaces with at least one of the first and second opposing members when the hinged gate is in the closed position; and

a second side rail, wherein the second side rail includes a second side gate projection extending at least partially into the hinged gate opening and the second side rail interfaces with at least one of the first and second opposing members when the hinged gate is in the closed position.

2. The safety rail protection system of claim **1**, further comprising a back rail member positioned substantially between the first side rail and the second side rail.

3. The safety rail protection system of claim **1**, wherein the hinged gate couples with the first side gate projection at an interface.

4. The safety rail protection system of claim **3**, further comprising a hinge structure positioned adjacent to the interface of the hinged gate and the first side gate projection.

5. The safety rail protection system of claim **4**, wherein the hinge structure comprises a hinge housing having a generally cylindrical shaft opening with at least one recess, and a generally cylindrical hinge shaft having at least one protrusion, wherein at least a portion of said shaft is positioned within said shaft opening, and wherein said protrusion interfaces with said recess to limit the rotation of the shaft within the hinge housing.

6. The safety rail protection system of claim **3**, further comprising a biasing structure positioned adjacent to the interface of the hinged gate and the first side gate projection.

7. The safety rail protection system of claim **1**, wherein the hinged gate couples with the second side gate projection at an interface.

8. The safety rail protection system of claim **7**, wherein the interface comprises a latching structure positioned adjacent the hinged gate and the second side gate projection.

9. The safety rail protection system of claim **1**, wherein the first side rail further includes a first side hand-grip projection operable to provide a second gripping surface to aid in at least one of ingress and egress through the portal.

10. The safety rail protection system of claim **1**, wherein the second side rail further includes a second side hand-grip projection operable to provide a third gripping surface to aid in at least one of ingress and egress through the portal.

11. The safety rail protection system of claim **1**, wherein the first side rail and the second side rail each further comprise a cross rail member.

12. The safety rail protection system of claim **1**, wherein in the closed position the hinged gate interfaces with the first side gate projection and the second side gate projection, and wherein in the open position the hinged gate interfaces with only one of the first side gate projection and the second side gate projection.

13. The safety rail protection system of claim **1**, further comprising a front mounting projection and a rear mounting projection.

14. The safety rail protection system of claim **13**, wherein at least one of the front mounting projection and the rear

mounting projection extends substantially perpendicular to at least one of the first side rail and the second side rail in at least one plane.

15. The safety rail protection system of claim **13**, further comprising a mounting structure, for attachment adjacent to the portal, having an opening for receiving at least one of a portion of the front mounting projection and the rear mounting projection.

16. The safety rail protection system of claim **13**, wherein at least one of the front mounting projection and the rear mounting projection are mounted adjacent to the portal using a fastener.

17. The safety rail protection system of claim **1**, wherein the hinged gate is not operable to open inwardly into a volume formed between the first side rail and the second side rail.

18. The safety rail protection system of claim **1**, wherein a primary plane of the hinged gate is positioned at an acute angle from vertical such that the hinged gate operates at least partially using gravity.

19. The safety rail protection system of claim **1**, wherein the hinged gate does not open past a set distance from a closed resting position of the hinged gate.

20. The safety rail protection system of claim **1**, wherein the hinged gate is biased to return to the closed position after being placed in the open position by being angled with respect to a surface of the earth such that gravity pulls the hinged gate toward the closed position when in the open position.

21. The safety rail protection system of claim **1**, wherein the hinged gate is biased to return to the closed position after being placed in the open position by a spring.

22. The safety rail protection system of claim **1**, wherein the first side gate projection interfaces with at least one of the first and second opposing members when the hinged gate is in the closed position; and wherein the second side gate projection interfaces with at least one of the first and second opposing members when the hinged gate is in the closed position.

23. The safety rail protection system of claim **1**, wherein the first side gate projection interfaces with each of the first and second opposing members when the hinged gate is in the closed position; and wherein the second side gate projection interfaces with each of the first and second opposing members when the hinged gate is in the closed position.

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